EXHIBIT D

Exhibit A-22

Invalidity Claim Chart for U.S. Patent No. 7,924,802 vs. "Analysis of Effects of Clipping and Filtering on the Performance of MB-OFDM UWB Signals"

Analysis of Effects of Clipping and Filtering on the Performance of MB-OFDM UWB Signals by K. Deergha Rao ("Rao") was published no later than 2007. Rao anticipates asserted claims 1–4, 6–10, 13, 14, 17, and 21–24 of U.S. Patent No. 7,924,802 ("the '802 Patent") under 35 U.S.C. § 102. Rao also renders obvious asserted claims 1–4, 6–10, 13, 14, 17, and 21–24 of the '802 Patent under 35 U.S.C. § 103, alone based on the state of the art and/or in combination with one or more other references identified in Exs. A-1–A-31, Cover Pleading, and First Supplemental Ex. A-Obviousness Chart.[1]

To the extent Plaintiff alleges that Rao does not disclose any particular limitation of the asserted claims in the '802 Patent, either expressly or inherently, it would have been obvious to a person of ordinary skill in the art as of the priority date of the '802 Patent to modify Rao and/or to combine the teachings of Rao with other prior art references, including but not limited to the present prior art references found in Exs. A-1–A-31, Cover Pleading, First Supplemental Ex. A-Obviousness Chart, and the relevant section of charts for other prior art for the '802 Patent in a manner that would render the asserted claims of these patents invalid as obvious.

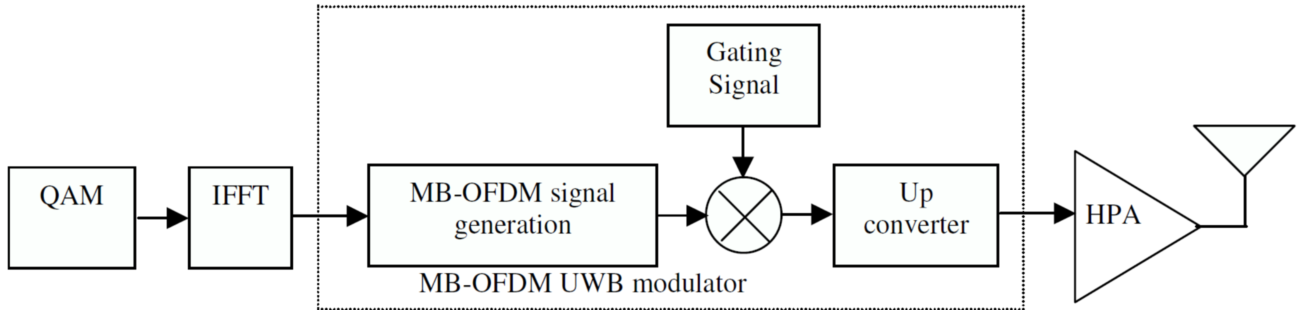
With respect to the obviousness of the asserted claims of the '802 Patent under 35 U.S.C. § 103, one or more of the principles enumerated by the United States Supreme Court in *KSR v. Teleflex*, 550 U.S. 398 (2007) apply, including: (a) combining various claimed elements known in the prior art according to known methods to yield a predictable result; and/or (b) making a simple substitution of one or more known elements for another to obtain a predictable result; and/or (c) using a known technique to improve a similar device or method in the same way; and/or (d) applying a known technique to a known device or method ready for improvement to yield a predictable result; and/or (e) choosing from a finite number of identified, predictable solutions with a reasonable expectation of success or, in other words, the solution was one which was "obvious to try"; and/or (f) a known work in one field of endeavor prompting variations of it for use either in the same field or a different field based on given design incentives or other market forces in which the variations were predictable to one of ordinary skill in the art; and/or (g) a teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference or to combine the

[1] Samsung is investigating this prior art and has not yet completed discovery from third parties, who may have relevant information concerning the prior art, and therefore, Samsung reserves the right to supplement this chart after additional discovery is received. To the extent that any of the prior art discloses the same or similar functionality or feature(s) of any of the accused products, Samsung reserves the right to argue that said feature or functionality does not practice any limitation of any of the asserted claims, and to argue, in the alternative, that if said feature or functionality is found to practice any limitation of any of the asserted claims in the '802 Patent, then the prior art reference teaches the limitation and that the claim is not patentable.

teachings of various prior art references to arrive at the claimed invention. It therefore would have been obvious to one of ordinary skill in the art to combine the disclosures of these references in accordance with the principles and rationales set forth above.

The citations to portions of any reference in this chart are exemplary only. For example, a citation that refers to or discusses a figure or figure item should be understood to also incorporate by reference that figure and any additional descriptions of that figure as if set forth fully therein. Samsung reserves the right to rely on the entirety of the references cited in this chart to show that the asserted claims of the ’802 Patent are invalid. Citations presented for one claim limitation are expressly incorporated by reference into all other limitations for that claim as well as all limitations of all claims on which that claim depends. Samsung also reserves the right to rely on additional citations or sources of evidence that also may be applicable, or that may become applicable in light of claim construction, changes in Plaintiff’s infringement contentions, and/or information obtained during discovery as the case progresses.

Claim 1 of the ’802 Patent	**Prior Art Reference – Rao**
[1.1] A method of transmitting information in a wireless communication channel comprising:	To the extent the preamble is limiting, Rao discloses “A method of transmitting information in a wireless communication channel comprising.” See, e.g.: UWB technology is a wireless protocol for high-speed data transmission over short distances and has recently received a lot of interest from the wireless manufacturing and user community [1]. The Federal Communications Commission (FCC) has approved to operate UWB in the 3.1- 10.6GHz band at a low effective isotropic radiated power(EIRP) of -41.3 dBm/MHz with a minimum signal bandwidth of 500MHz. In near future, UWB communication system will be extensively used in the mobile handsets or consumer device that require real-time transmission of highdefinition multimedia data. *See, e.g.*, Rao at 559. Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further

Claim 1 of the ’802 Patent	**Prior Art Reference – Rao**
	motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[1.2] transmitting first information across a first frequency range using a wireless transmitter, the first frequency range having a first center frequency, a first highest frequency, and a first lowest frequency; and	Rao discloses “transmitting first information across a first frequency range using a wireless transmitter, the first frequency range having a first center frequency, a first highest frequency, and a first lowest frequency.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth.

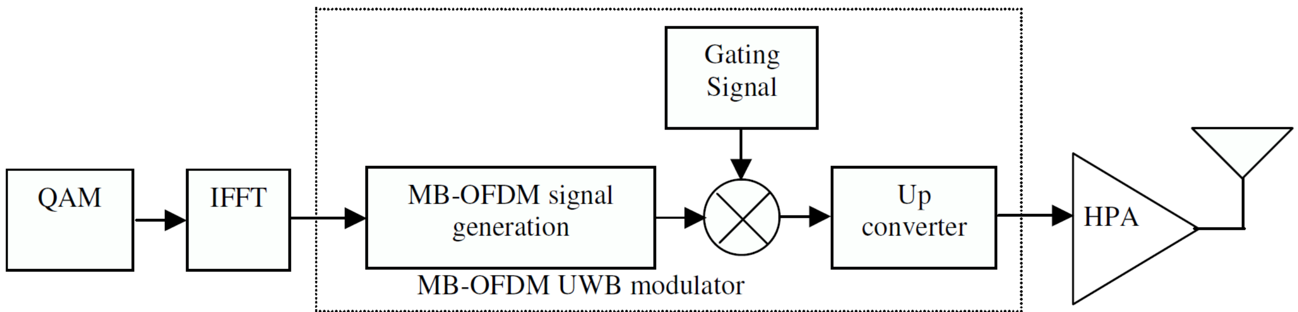
Claim 1 of the '802 Patent	Prior Art Reference – Rao
	Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots, N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3) where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t =$ 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and ℜ denotes the real part of a complex number.

Claim 1 of the ’802 Patent	Prior Art Reference – Rao
	Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See*, *e.g.*, Rao at 560.

Claim 1 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 1 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[1.3] simultaneously transmitting second information across a second frequency range using the same wireless transmitter, the second frequency range having a second center frequency greater than the first center frequency, a second highest frequency, and a second lowest frequency.	Rao discloses “simultaneously transmitting second information across a second frequency range using the same wireless transmitter, the second frequency range having a second center frequency greater than the first center frequency, a second highest frequency, and a second lowest frequency.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14 (MHz)$.

Claim 1 of the ’802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

Claim 1 of the '802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

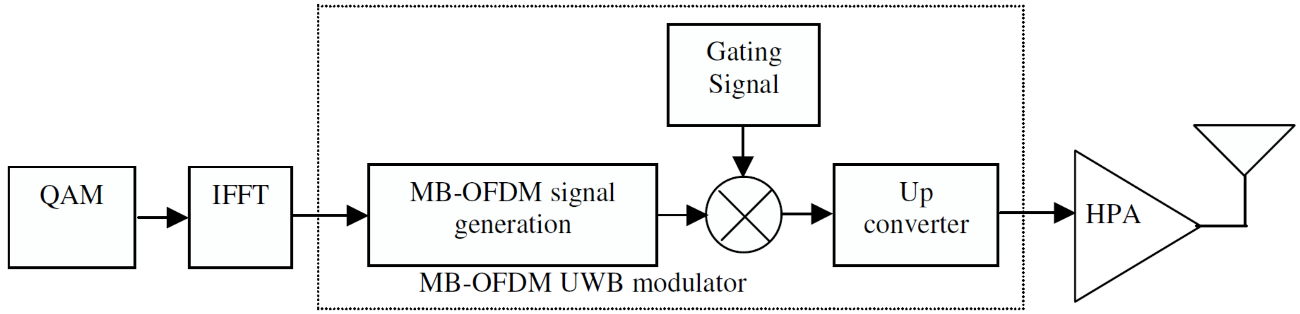
Claim 1 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 1 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 2 of the '802 Patent	Prior Art Reference – Rao
[2.1] The method of claim 1	Rao discloses all the elements of claim 1 for all the reasons provided above.
[2.2] wherein frequency difference between the first center frequency and the second center frequency is greater than the sum of one-half the first frequency range and one-half the second frequency range.	Rao discloses "wherein frequency difference between the first center frequency and the second center frequency is greater than the sum of one-half the first frequency range and one-half the second frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1.

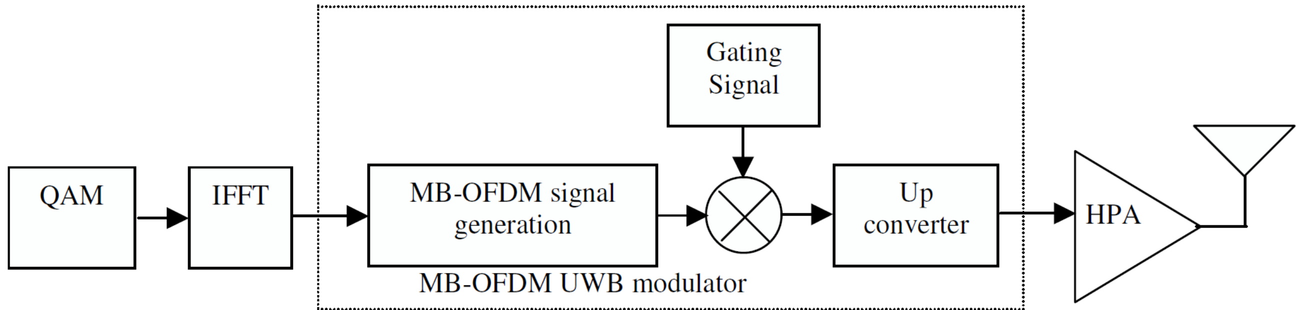
Claim 2 of the '802 Patent	Prior Art Reference – Rao
	One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See, e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$

Claim 2 of the '802 Patent	Prior Art Reference – Rao
	Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 2 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (see table below) *See, e.g.*, Rao at Table 1.

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

Claim 2 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 3 of the ’802 Patent	Prior Art Reference – Rao
[3.1] The method of claim 1	Rao discloses all the elements of claim 1 for all the reasons provided above.
[3.2] wherein the first and second information are transmitted using the same power amplifier in said wireless transmitter.	Rao discloses “wherein the first and second information are transmitted using the same power amplifier in said wireless transmitter.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 3 of the ’802 Patent	**Prior Art Reference – Rao**
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots, N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

Claim 3 of the ’802 Patent	**Prior Art Reference – Rao**
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and ℜ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

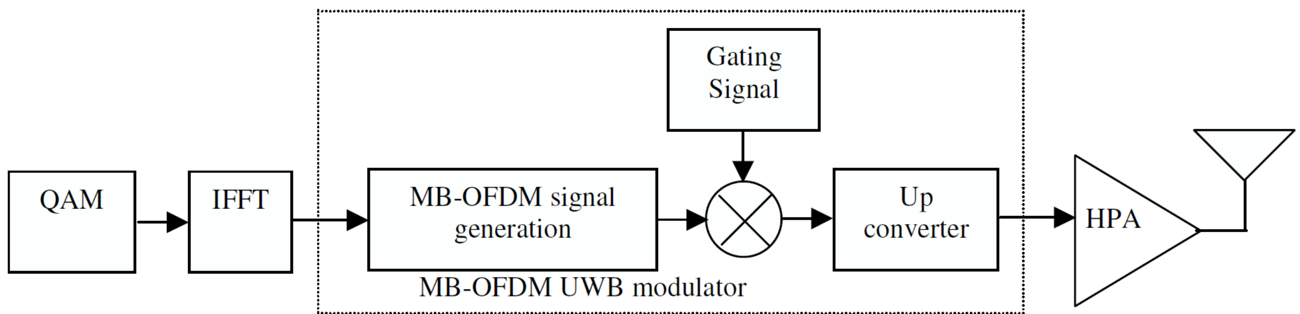
Claim 3 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 3 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 4 of the '802 Patent	Prior Art Reference – Rao
[4.1] The method of claim 3	Rao discloses all the elements of claim 3 for all the reasons provided above.
[4.2] wherein the bandwidth of said power amplifier is greater than the difference between the first lowest frequency and the second highest frequency.	Rao discloses "wherein the bandwidth of said power amplifier is greater than the difference between the first lowest frequency and the second highest frequency." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 4 of the '802 Patent	Prior Art Reference – Rao
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

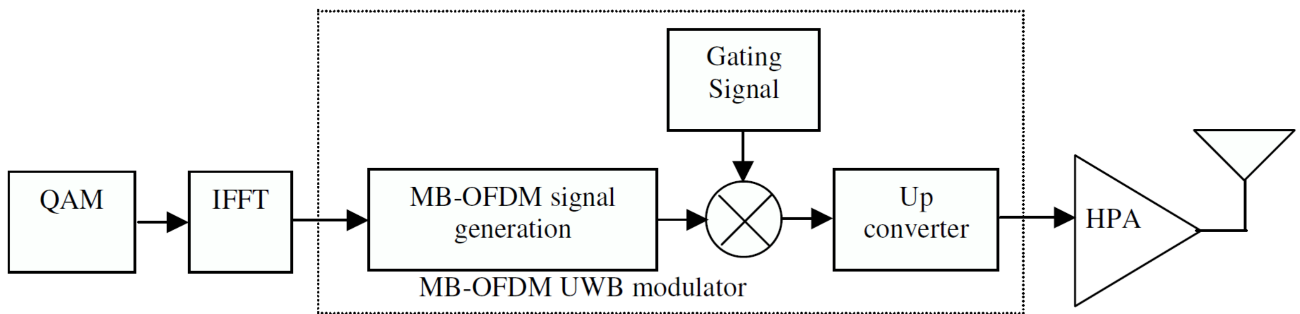
Claim 4 of the '802 Patent	Prior Art Reference – Rao
	$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \quad (3)$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 4 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 4 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 6 of the ’802 Patent	Prior Art Reference – Rao
[6.1] The method of claim 1	Rao discloses all the elements of claim 1 for all the reasons provided above.
[6.2] wherein the first information corresponds to a first wireless protocol and the second information corresponds to a second wireless protocol.	Rao discloses “wherein the first information corresponds to a first wireless protocol and the second information corresponds to a second wireless protocol.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 6 of the '802 Patent	Prior Art Reference – Rao
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2, \ldots, N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as

Claim 6 of the ’802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l}h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

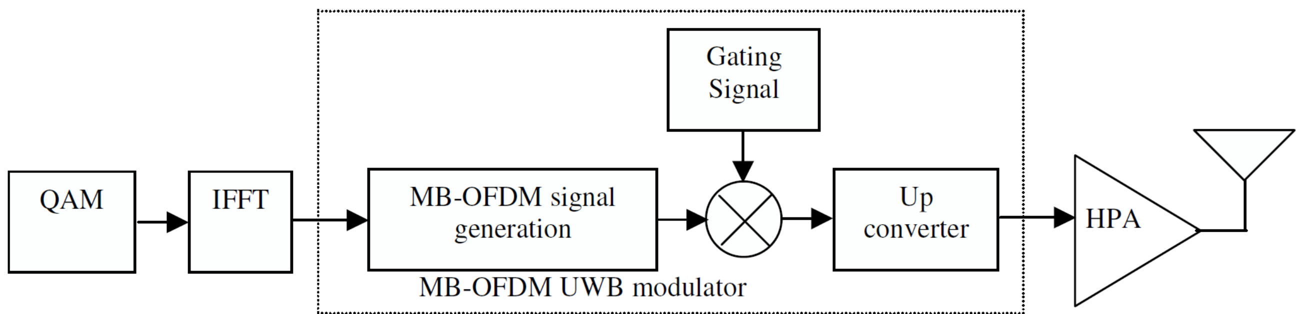
Claim 6 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 6 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 7 of the '802 Patent	Prior Art Reference – Rao
[7.1] The method of claim 1	Rao discloses all the elements of claim 1 for all the reasons provided above.
[7.2] wherein the first information and the second information are the same data transmitted across two different frequencies.	Rao discloses "wherein the first information and the second information are the same data transmitted across two different frequencies." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 7 of the '802 Patent	**Prior Art Reference – Rao**
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14 (MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as

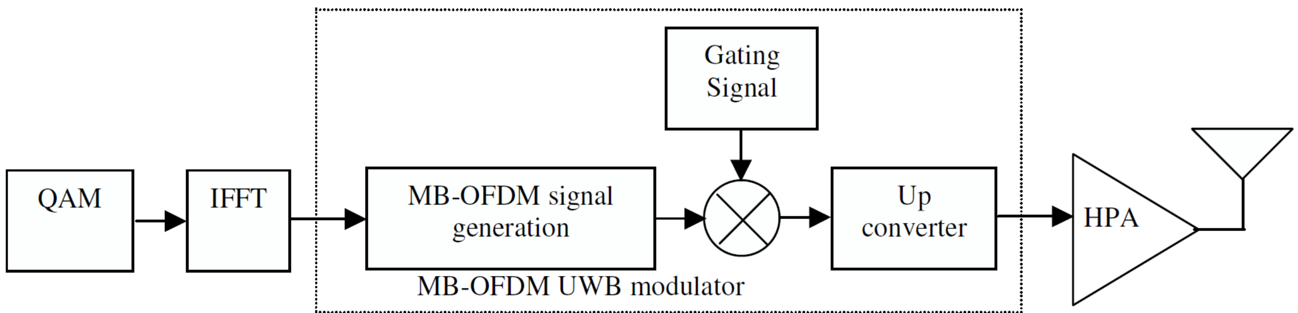
Claim 7 of the ’802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 7 of the ’802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, *e.g.*, Rao at Table 1.

Claim 7 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 8 of the '802 Patent	Prior Art Reference – Rao
[8.1] The method of claim 1	Rao discloses all the elements of claim 1 for all the reasons provided above.
[8.2] wherein the first information and the second information are from the same data stream.	Rao discloses "wherein the first information and the second information are from the same data stream." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 8 of the '802 Patent	Prior Art Reference – Rao
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots, N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

Claim 8 of the ’802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and ℜ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 8 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

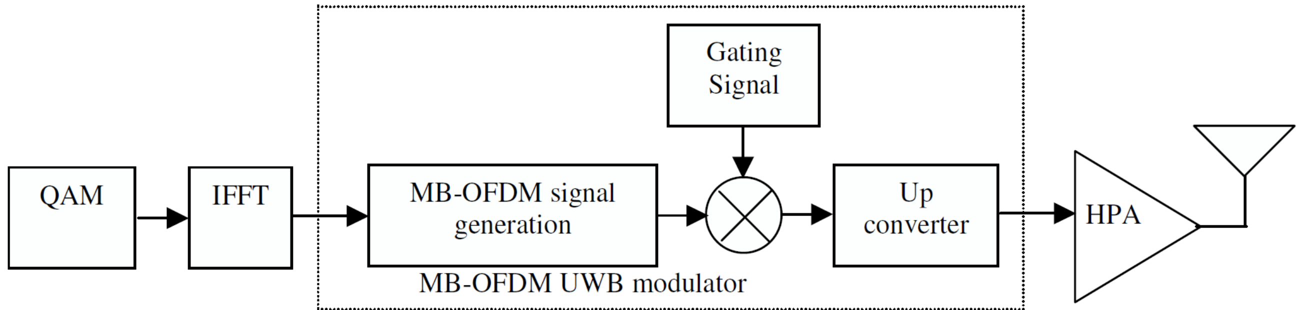
Claim 8 of the '802 Patent	**Prior Art Reference – Rao**
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 9 of the '802 Patent	**Prior Art Reference – Rao**
[9.1] The method of claim 1	Rao discloses all the elements of claim 1 for all the reasons provided above.
[9.2] wherein first information and second information comprise a plurality of OFDM symbols, wherein a first symbol is transmitted during a first time slot across the first frequency range and a second symbol is transmitted during the first time slot across the second frequency range, and wherein a third symbol is transmitted during a second time slot across the first frequency range and a fourth symbol is transmitted during the second time slot across a second frequency range.	Rao discloses "wherein first information and second information comprise a plurality of OFDM symbols, wherein a first symbol is transmitted during a first time slot across the first frequency range and a second symbol is transmitted during the first time slot across the second frequency range, and wherein a third symbol is transmitted during a second time slot across the first frequency range and a fourth symbol is transmitted during the second time slot across a second frequency range." See, e.g.: One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility.

Claim 9 of the '802 Patent	**Prior Art Reference – Rao**
	See, e.g., Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3) where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2].

Claim 9 of the '802 Patent	Prior Art Reference – Rao
	See, e.g., Rao at 560. Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
[10.1] A method of transmitting information in a wireless communication channel comprising:	To the extent the preamble is limiting, Rao discloses "A method of transmitting information in a wireless communication channel comprising." See, e.g.: UWB technology is a wireless protocol for high-speed data transmission over short distances and has recently received a lot of interest from the wireless manufacturing and user community [1]. The Federal Communications Commission (FCC) has approved to operate UWB in the 3.1- 10.6GHz band at a low effective isotropic radiated power(EIRP) of -41.3 dBm/MHz with a minimum signal bandwidth of 500MHz. In near future, UWB communication system will be extensively used in the mobile handsets or consumer device that require real-time transmission of highdefinition multimedia data. *See, e.g.*, Rao at 559. Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.2] receiving a first digital signal comprising first data to be transmitted;	Rao discloses "receiving a first digital signal comprising first data to be transmitted." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth.

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See, e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3) where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t =$ 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See*, *e.g.*, Rao at 560.

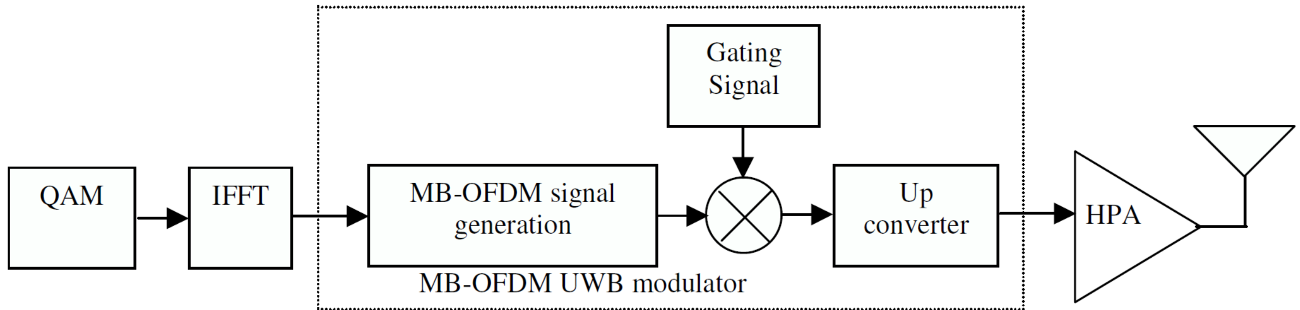
<table>
<tr><th>Claim 10 of the ’802 Patent</th><th>Prior Art Reference – Rao</th></tr>
<tr><td></td><td>

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

</td></tr>
</table>

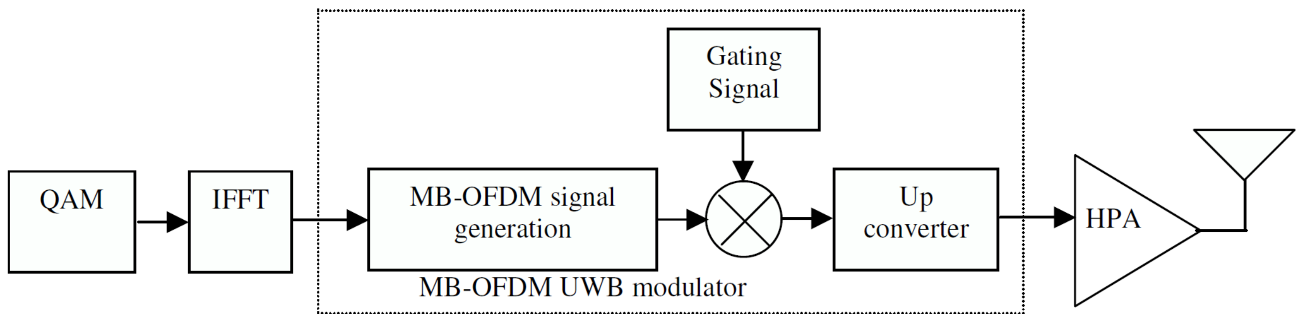
Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.3] receiving a second digital signal comprising second data to be transmitted;	Rao discloses "receiving a second digital signal comprising second data to be transmitted." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$

Claim 10 of the ’802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 10 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (see table below) *See, e.g.*, Rao at Table 1.

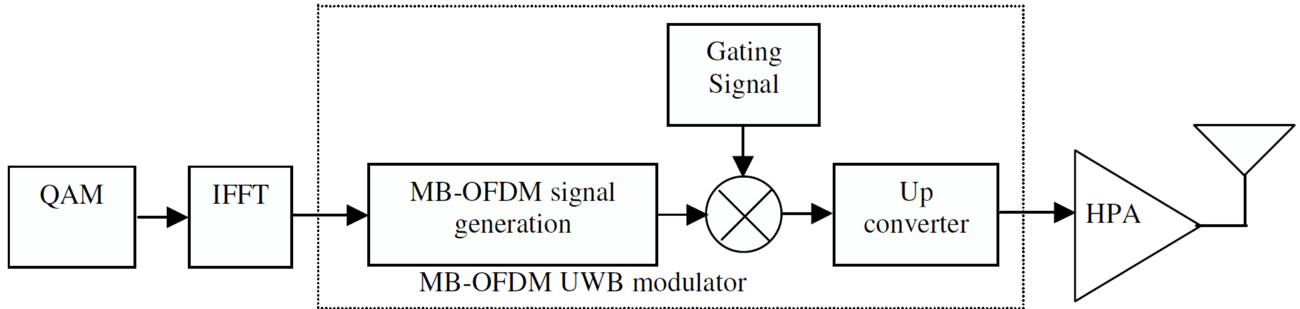
Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.4] converting the first digital signal into a first analog signal using a first digital-to-analog converter, the first analog signal carrying the first data across a first frequency range;.	Rao discloses “converting the first digital signal into a first analog signal using a first digital-to-analog converter, the first analog signal carrying the first data across a first frequency range.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \; (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

<table>
<tr><th>Claim 10 of the ’802 Patent</th><th>Prior Art Reference – Rao</th></tr>
<tr><td></td><td>
TABLE 1 – OFDM PHY BAND ALLOCATION
<table>
<tr><th>Band Group</th><th>Band ID</th><th>Lower Frequency (MHz)</th><th>Center Frequency (MHz)</th><th>Upper Frequency (MHz)</th></tr>
<tr><td rowspan="3">1</td><td>1</td><td>3168</td><td>3432</td><td>3696</td></tr>
<tr><td>2</td><td>3696</td><td>3960</td><td>4224</td></tr>
<tr><td>3</td><td>4224</td><td>4488</td><td>4752</td></tr>
<tr><td rowspan="3">2</td><td>4</td><td>4752</td><td>5016</td><td>5280</td></tr>
<tr><td>5</td><td>5280</td><td>5544</td><td>5808</td></tr>
<tr><td>6</td><td>5808</td><td>6072</td><td>6336</td></tr>
<tr><td rowspan="3">3</td><td>7</td><td>6336</td><td>6600</td><td>6864</td></tr>
<tr><td>8</td><td>6864</td><td>7128</td><td>7392</td></tr>
<tr><td>9</td><td>7392</td><td>7656</td><td>7920</td></tr>
<tr><td rowspan="3">4</td><td>10</td><td>7920</td><td>8184</td><td>8488</td></tr>
<tr><td>11</td><td>8488</td><td>8712</td><td>8976</td></tr>
<tr><td>12</td><td>8976</td><td>9240</td><td>9504</td></tr>
<tr><td rowspan="2">5</td><td>13</td><td>9504</td><td>9768</td><td>10032</td></tr>
<tr><td>14</td><td>10032</td><td>10296</td><td>10560</td></tr>
</table>
See, e.g., Rao at Table 1.
</td></tr>
</table>

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.5] converting the second digital signal into a second analog signal using a second digital-to-analog converter, the second analog signal carrying the second data across a second frequency range;	Rao discloses "converting the second digital signal into a second analog signal using a second digital-to-analog converter, the second analog signal carrying the second data across a second frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

<table>
<tr><th>Claim 10 of the ’802 Patent</th><th>Prior Art Reference – Rao</th></tr>
<tr><td></td><td>Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.</td></tr>
<tr><td>[10.6] up-converting the first analog signal to a first RF center frequency to produce a first up-converted analog signal, wherein the first up-converted analog signal comprises a first up-converted frequency range from the first RF center frequency minus one-half the first frequency range to the first RF center frequency plus one-half the first frequency range;</td><td>Rao discloses “up-converting the first analog signal to a first RF center frequency to produce a first up-converted analog signal, wherein the first up-converted analog signal comprises a first up-converted frequency range from the first RF center frequency minus one-half the first frequency range to the first RF center frequency plus one-half the first frequency range.” See, e.g.:

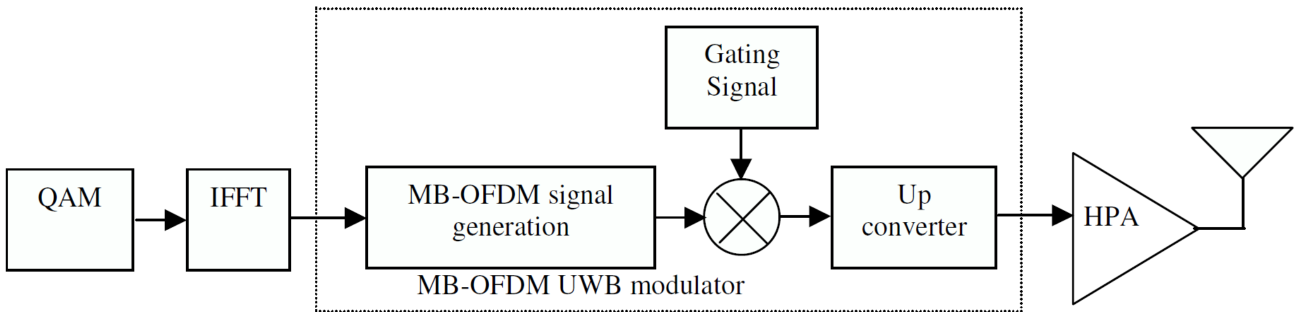


Figure 1. MB-OFDM UWB signal transmitter

See, e.g., Rao at Figure 1.

One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.</td></tr>
</table>

Claim 10 of the '802 Patent	**Prior Art Reference – Rao**
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 10 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

<table>
<tr><th>Claim 10 of the ’802 Patent</th><th>Prior Art Reference – Rao</th></tr>
<tr><td></td><td>Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.</td></tr>
<tr><td>[10.7] up-converting the second analog signal to a second RF center frequency greater than the first center RF frequency to produce a second up-converted analog signal, wherein the second up-converted analog signal comprises a second up-converted frequency range from the second RF center frequency minus one-half the second frequency range to the second RF center frequency plus one-half the second frequency range, and wherein a frequency difference between the first RF center frequency and the second RF center frequency is greater than the sum of one-half the first frequency range and one-half the second frequency range;</td><td>Rao discloses “up-converting the second analog signal to a second RF center frequency greater than the first center RF frequency to produce a second up-converted analog signal, wherein the second up-converted analog signal comprises a second up-converted frequency range from the second RF center frequency minus one-half the second frequency range to the second RF center frequency plus one-half the second frequency range, and wherein a frequency difference between the first RF center frequency and the second RF center frequency is greater than the sum of one-half the first frequency range and one-half the second frequency range.” See, e.g.:

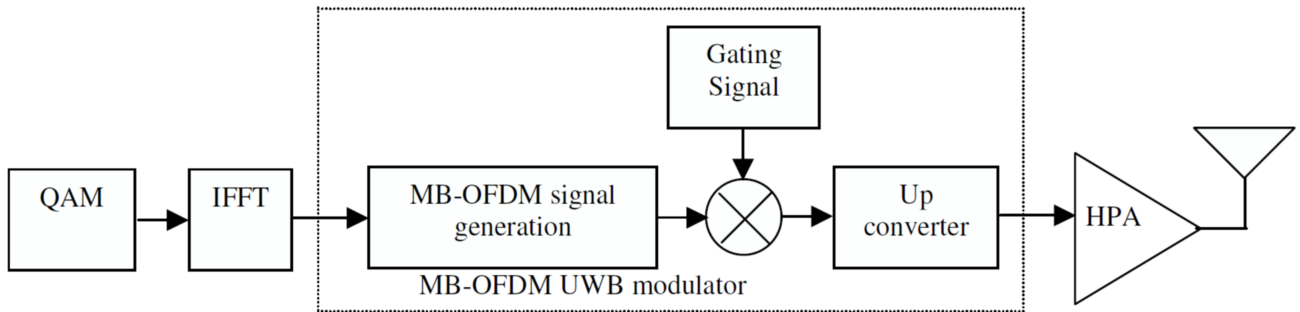


Figure 1. MB-OFDM UWB signal transmitter

See, e.g., Rao at Figure 1.

One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between</td></tr>
</table>

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14 (MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N} \sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2, \ldots, N-1 \; (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \quad (2)$$ Then the simulated MB-OFDM signal is mathematically described as

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \quad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

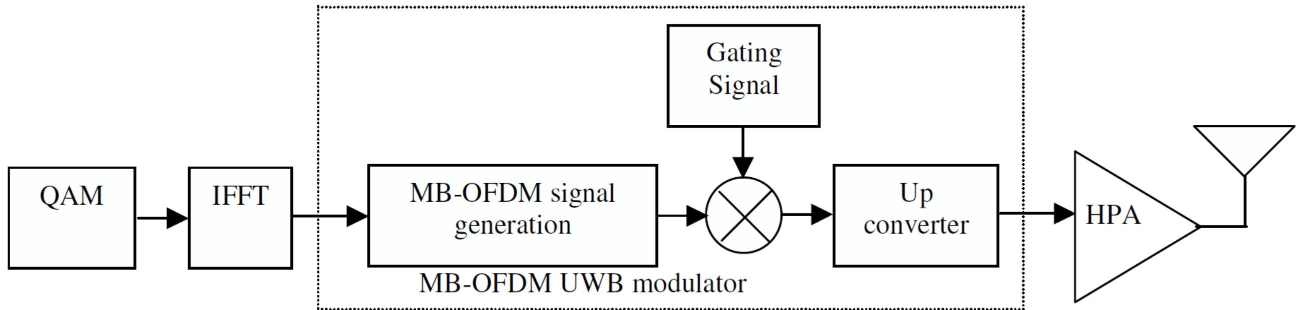
<table>
<tr><th>Claim 10 of the ’802 Patent</th><th>Prior Art Reference – Rao</th></tr>
<tr><td></td><td>

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

</td></tr>
</table>

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.8] combining the first up-converted analog signal and the second up-converted analog signal to produce a combined up-converted signal;	Rao discloses "combining the first up-converted analog signal and the second up-converted analog signal to produce a combined up-converted signal." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

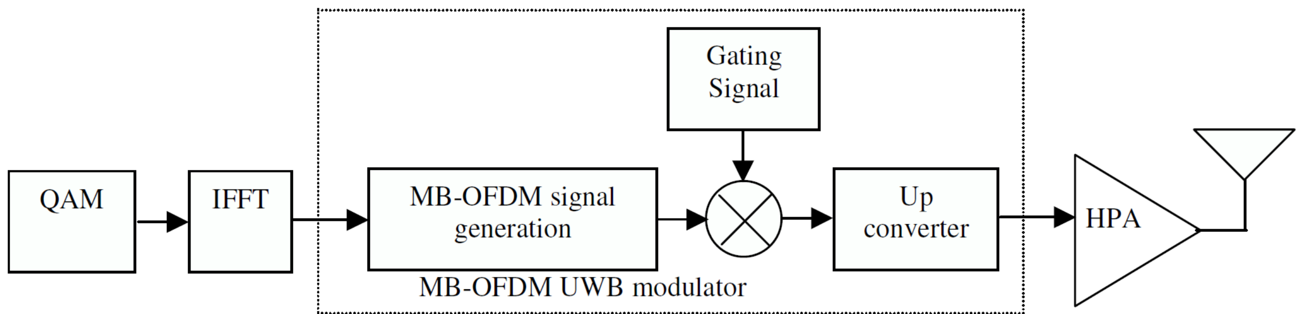
Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.9] amplifying the combined up-converted signal in a power amplifier resulting in an amplified combined up-converted signal; and	Rao discloses "amplifying the combined up-converted signal in a power amplifier resulting in an amplified combined up-converted signal." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the

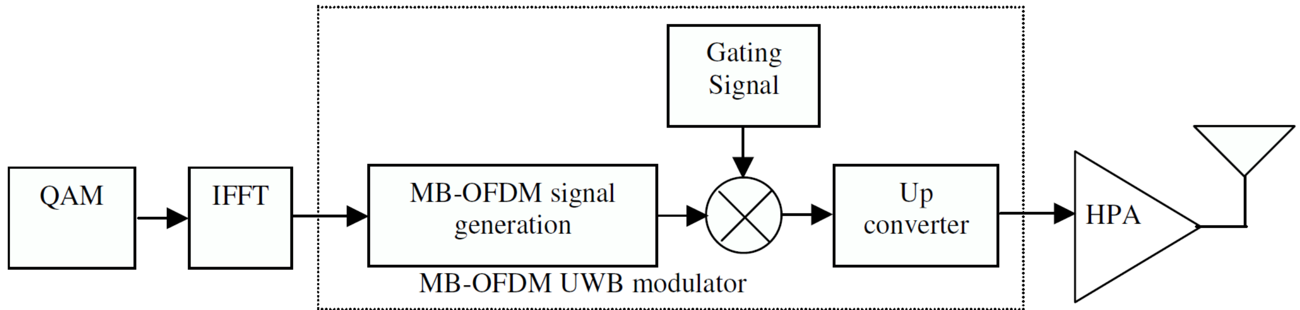
Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3) where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number.

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See*, *e.g.*, Rao at 560.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.10] transmitting the amplified combined up-converted signal on a first antenna,	Rao discloses “transmitting the amplified combined up-converted signal on a first antenna.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See, e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

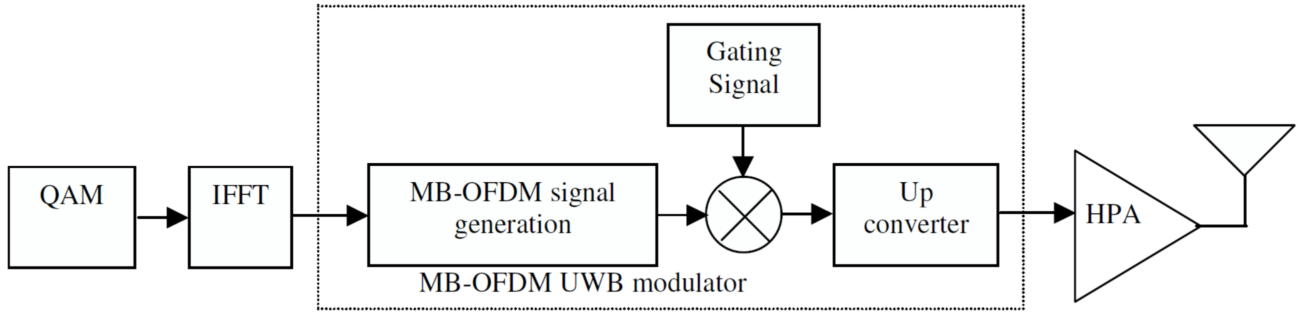
Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 10 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[10.11] wherein the bandwidth of said power amplifier is greater than the difference between a lowest frequency in the first up-converted frequency range and a highest frequency in the second up-converted frequency range.	Rao discloses "wherein the bandwidth of said power amplifier is greater than the difference between a lowest frequency in the first up-converted frequency range and a highest frequency in the second up-converted frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 10 of the ’802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

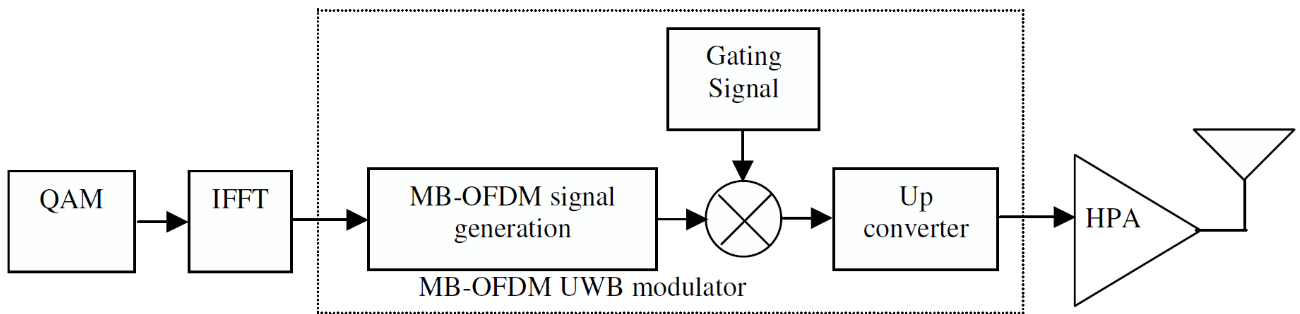
Claim 10 of the '802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 10 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 13 of the '802 Patent	Prior Art Reference – Rao
[13.1] The method of claim 10	Rao discloses all the elements of claim 10 for all the reasons provided above.
[13.2] wherein the first digital signal is encoded using a first wireless protocol and the second digital signal is encoded using a second wireless protocol.	Rao discloses "wherein the first digital signal is encoded using a first wireless protocol and the second digital signal is encoded using a second wireless protocol." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between

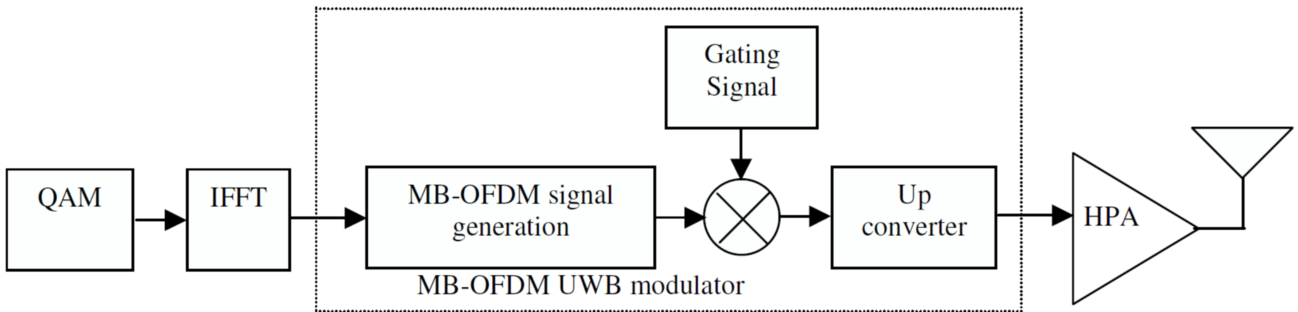
Claim 13 of the '802 Patent	Prior Art Reference – Rao
	center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

Claim 13 of the ’802 Patent	**Prior Art Reference – Rao**
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \quad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 13 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

Claim 13 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
[14.1] The method of claim 10	Rao discloses all the elements of claim 10 for all the reasons provided above.
[14.2] wherein the second data is the same as the first data, the method further comprising:	Rao discloses "wherein the second data is the same as the first data, the method further comprising." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \quad (2)$$ Then the simulated MB-OFDM signal is mathematically described as

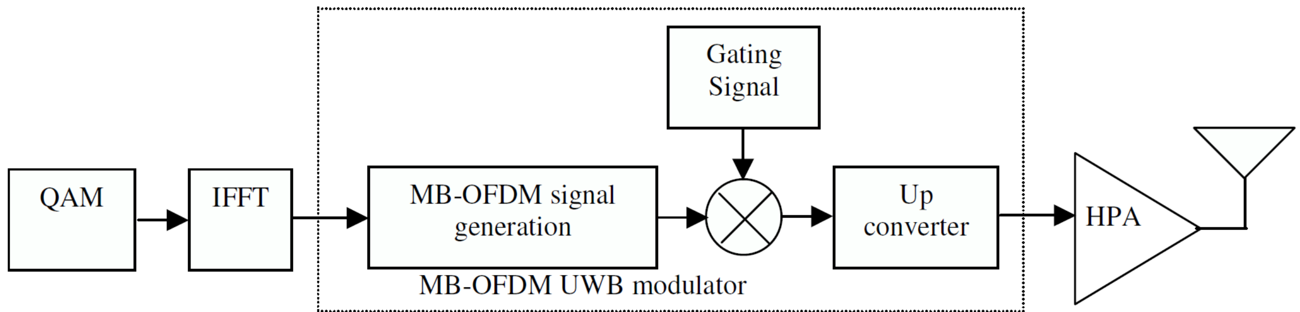
Claim 14 of the '802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[14.3] receiving the transmitted signal on a second antenna;	Rao discloses "receiving the transmitted signal on a second antenna." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

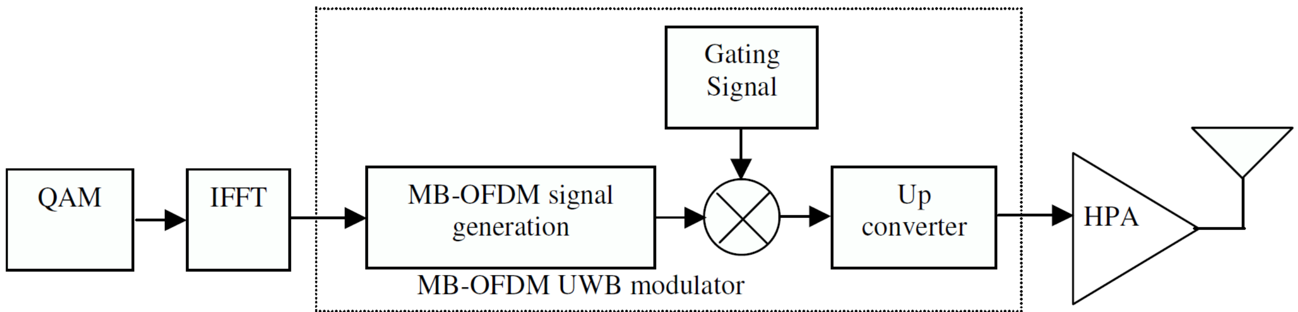
Claim 14 of the ’802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[14.4] amplifying the received signal in a low noise amplifier resulting in an amplified received up-converted signal, wherein the bandwidth of said low noise amplifier is greater than the difference between the lowest frequency in the first up-converted frequency range and the highest frequency in the second up-converted frequency range;	Rao discloses "amplifying the received signal in a low noise amplifier resulting in an amplified received up-converted signal, wherein the bandwidth of said low noise amplifier is greater than the difference between the lowest frequency in the first up-converted frequency range and the highest frequency in the second up-converted frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14 (MHz)$.

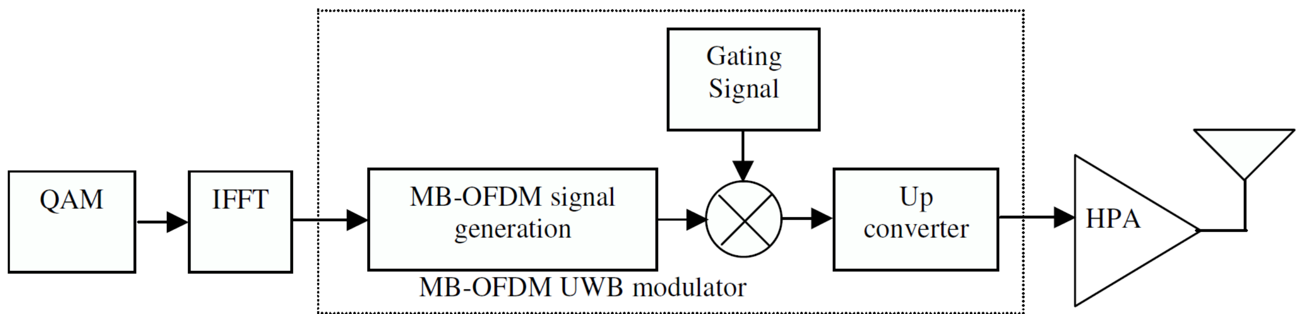
Claim 14 of the '802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \ (1)$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$ Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 14 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 14 of the '802 Patent	**Prior Art Reference – Rao**
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[14.5] down-converting the amplified received up-converted signal using a first down-converter and a signal corresponding to the first RF center frequency to produce a fourth analog signal corresponding to the first analog signal; and	Rao discloses "down-converting the amplified received up-converted signal using a first down-converter and a signal corresponding to the first RF center frequency to produce a fourth analog signal corresponding to the first analog signal." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 14 of the ’802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

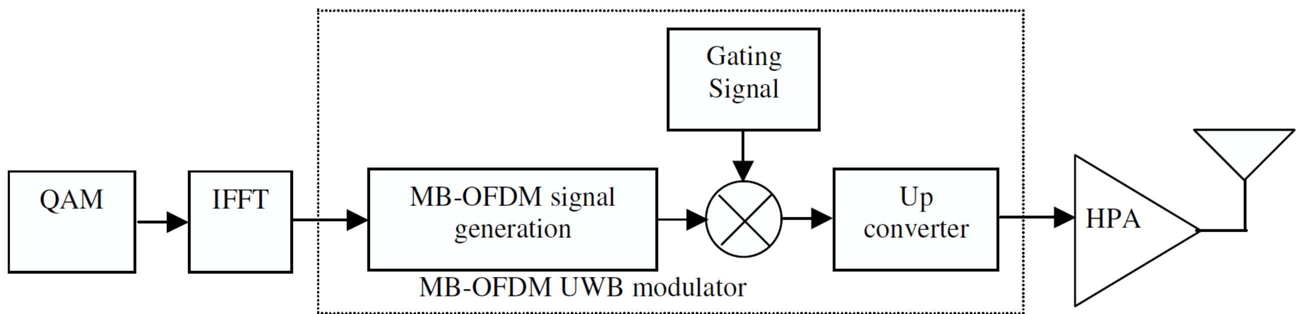
Claim 14 of the ’802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 14 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[14.6] down-converting the amplified received up-converted analog signal using a second down-converter and a signal corresponding to the second RF center frequency to produce a fifth analog signal corresponding to the second analog signal.	Rao discloses “down-converting the amplified received up-converted analog signal using a second down-converter and a signal corresponding to the second RF center frequency to produce a fifth analog signal corresponding to the second analog signal.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 14 of the '802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

Claim 14 of the ’802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 14 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

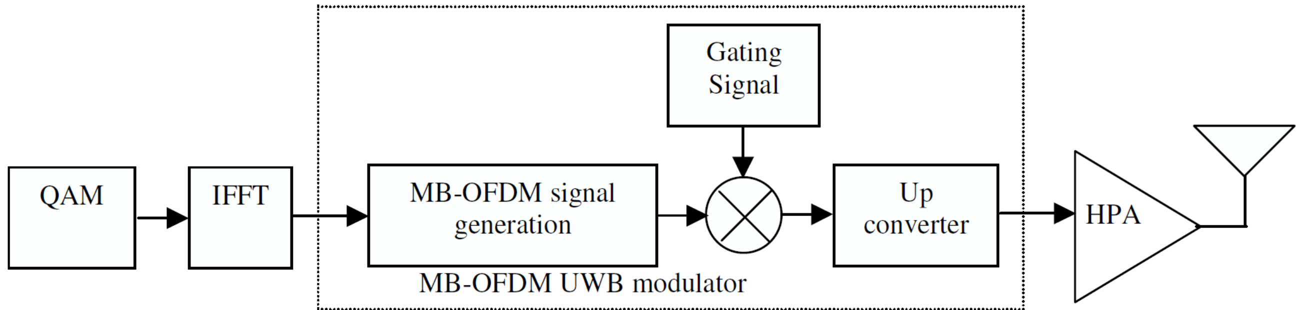
TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 14 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 17 of the ’802 Patent	Prior Art Reference – Rao
[17.1] A wireless communication system comprising:	To the extent the preamble is limiting, Rao discloses “A wireless communication system comprising.” See, e.g.: UWB technology is a wireless protocol for high-speed data transmission over short distances and has recently received a lot of interest from the wireless manufacturing and user community [1]. The Federal Communications Commission (FCC) has approved to operate UWB in the 3.1- 10.6GHz band at a low effective isotropic radiated power(EIRP) of -41.3 dBm/MHz with a minimum signal bandwidth of 500MHz. In near future, UWB communication system will be extensively used in the mobile handsets or consumer device that require real-time transmission of highdefinition multimedia data. *See, e.g.*, Rao at 559. Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

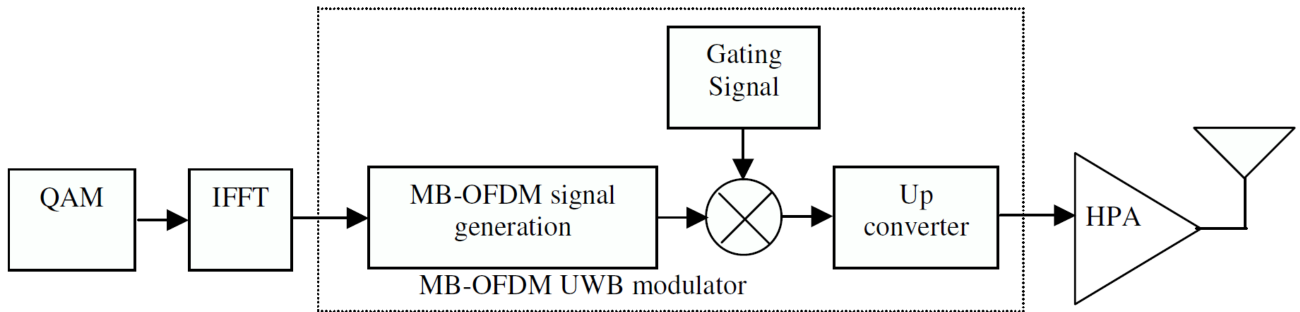
Claim 17 of the '802 Patent	Prior Art Reference – Rao
[17.2] a baseband digital system for providing a first digital signal comprising a first data to be transmitted and a second digital signal comprising a second data to be transmitted;	Rao discloses "a baseband digital system for providing a first digital signal comprising a first data to be transmitted and a second digital signal comprising a second data to be transmitted." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility.

Claim 17 of the '802 Patent	Prior Art Reference – Rao
	See, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1\ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2].

Claim 17 of the '802 Patent	Prior Art Reference – Rao
	See, e.g., Rao at 560. TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

Claim 17 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[17.3] a first digital-to-analog converter for receiving the first digital signal and converting the first digital signal into a first analog signal, the first analog signal carrying the first data across a first frequency range;	Rao discloses "a first digital-to-analog converter for receiving the first digital signal and converting the first digital signal into a first analog signal, the first analog signal carrying the first data across a first frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

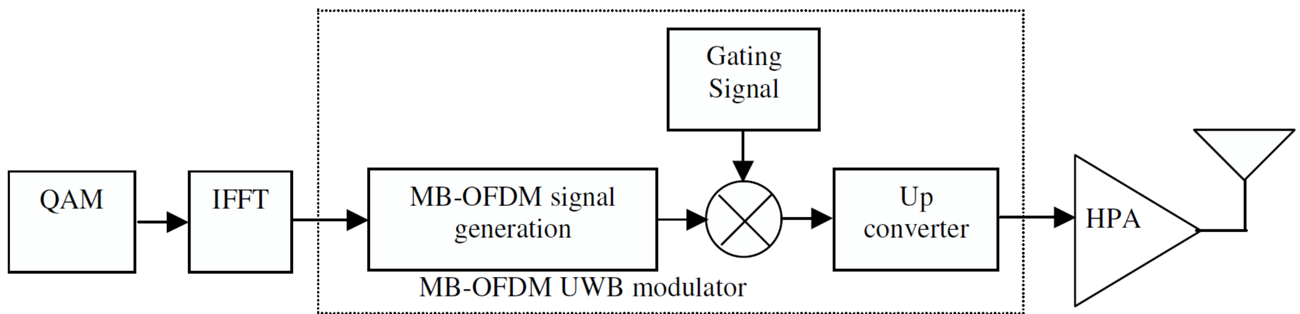
Claim 17 of the '802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \quad (2)$$ Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \quad (3)$$

Claim 17 of the '802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 17 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 17 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[17.4] a second digital-to-analog converter for receiving the second digital signal and converting the second digital signal into a second analog signal, the second analog signal carrying the second data across a second frequency range;	Rao discloses “a second digital-to-analog converter for receiving the second digital signal and converting the second digital signal into a second analog signal, the second analog signal carrying the second data across a second frequency range.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

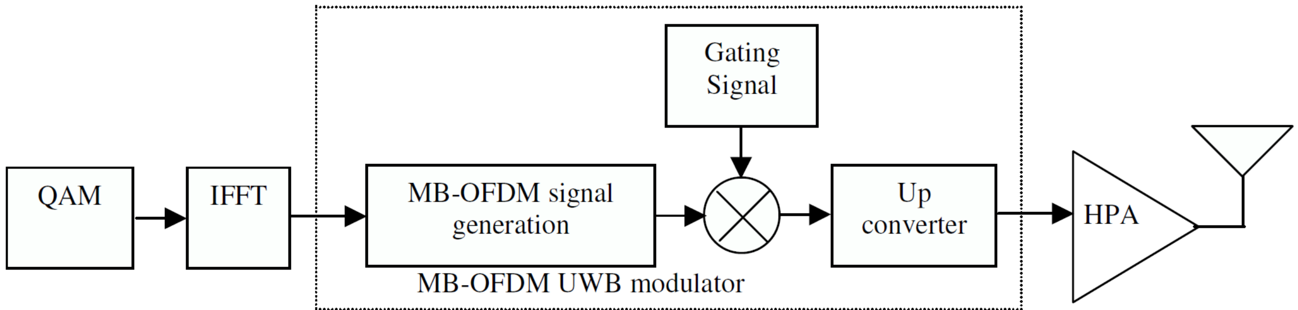
Claim 17 of the '802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See, e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

Claim 17 of the ’802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 17 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, *e.g.*, Rao at Table 1.

Claim 17 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[17.5] a first up-converter circuit having a first input coupled to receive the first analog signal and a second input coupled to receive a first modulation signal having a first RF frequency, wherein the first up-converter outputs a first up-converted analog signal comprising a first up-converted frequency range from the first RF frequency minus one-half the first frequency range to the first RF frequency plus one-half the first frequency range;	Rao discloses "a first up-converter circuit having a first input coupled to receive the first analog signal and a second input coupled to receive a first modulation signal having a first RF frequency, wherein the first up-converter outputs a first up-converted analog signal comprising a first up-converted frequency range from the first RF frequency minus one-half the first frequency range to the first RF frequency plus one-half the first frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 17 of the ’802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

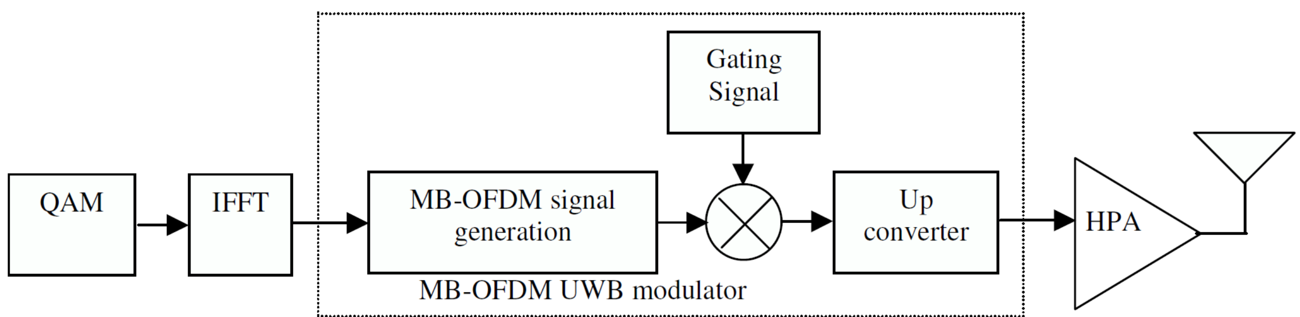
Claim 17 of the ’802 Patent	Prior Art Reference – Rao
	$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \quad (3)$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 17 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (see table below)
	See, *e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, *e.g.*, Rao at Table 1.

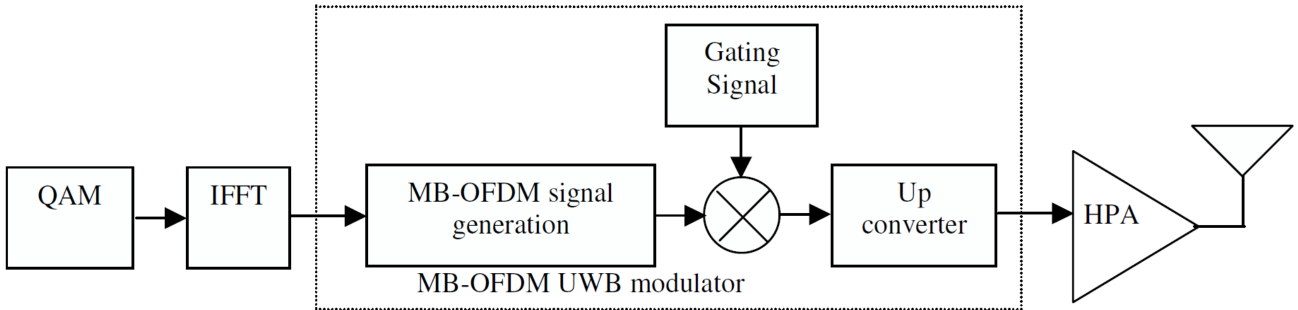
Claim 17 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[17.6] a second up-converter circuit having a first input coupled to receive the second analog signal and a second input coupled to receive a second modulation signal having a second RF frequency, wherein the second up-converter outputs a second up-converted analog signal comprising a second up-converted frequency range from the second RF frequency minus one-half the second frequency range to the second RF frequency plus one-half the second frequency range, and wherein frequency difference between the first RF frequency and the second RF frequency is greater than the sum of one-half the first frequency range and one-half	Rao discloses "a second up-converter circuit having a first input coupled to receive the second analog signal and a second input coupled to receive a second modulation signal having a second RF frequency, wherein the second up-converter outputs a second up-converted analog signal comprising a second up-converted frequency range from the second RF frequency minus one-half the second frequency range to the second RF frequency plus one-half the second frequency range, and wherein frequency difference between the first RF frequency and the second RF frequency is greater than the sum of one-half the first frequency range and one-half the second frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between

Claim 17 of the '802 Patent	**Prior Art Reference – Rao**
the second frequency range; and	center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots, N-1 \ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \quad (2)$$ Then the simulated MB-OFDM signal is mathematically described as

Claim 17 of the ’802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \quad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 17 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

Claim 17 of the '802 Patent	**Prior Art Reference – Rao**
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[17.7] a power amplifier coupled to receive the first and second up-converted analog signals, wherein the bandwidth of the power amplifier is greater than the difference between a lowest frequency in the first up-converted frequency range and a highest frequency in the second up-converted frequency range.	Rao discloses "a power amplifier coupled to receive the first and second up-converted analog signals, wherein the bandwidth of the power amplifier is greater than the difference between a lowest frequency in the first up-converted frequency range and a highest frequency in the second up-converted frequency range." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See*, *e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14 (MHz)$.

Claim 17 of the ’802 Patent	**Prior Art Reference – Rao**
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1\ (1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as $$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$

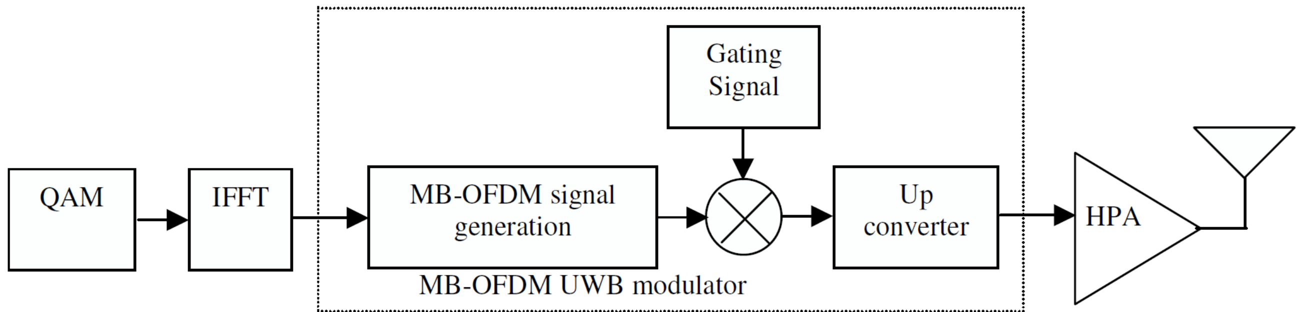
Claim 17 of the '802 Patent	Prior Art Reference – Rao
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 17 of the ’802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 17 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 21 of the ’802 Patent	Prior Art Reference – Rao
[21.1] The communication system of claim 17	Rao discloses all the elements of claim 17 for all the reasons provided above.
[21.2] wherein the first data of the first digital signal is encoded using a first wireless protocol and the first data of the second digital signal is encoded using a second wireless protocol.	Rao discloses “wherein the first data of the first digital signal is encoded using a first wireless protocol and the first data of the second digital signal is encoded using a second wireless protocol.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 21 of the '802 Patent	Prior Art Reference – Rao
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $$d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1 \;(1)$$ where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $$u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases} \qquad (2)$$ Then the simulated MB-OFDM signal is mathematically described as

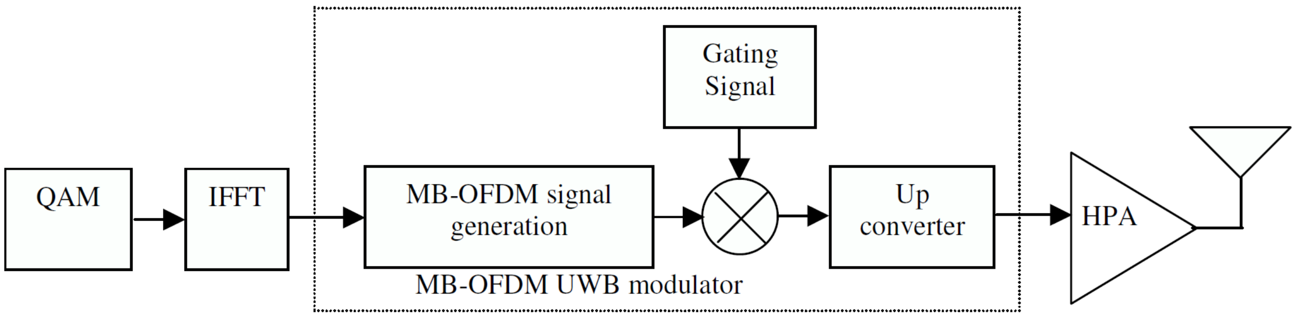
Claim 21 of the '802 Patent	**Prior Art Reference – Rao**
	$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 21 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 21 of the ’802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 22 of the ’802 Patent	Prior Art Reference – Rao
[22.1] The communication system of claim 17	Rao discloses all the elements of claim 17 for all the reasons provided above.
[22.2] wherein the second data corresponds to the first data and wherein the power amplifier outputs a third up-converted signal comprising the up-converted first analog signal and the up-converted second analog signal.	Rao discloses “wherein the second data corresponds to the first data and wherein the power amplifier outputs a third up-converted signal comprising the up-converted first analog signal and the up-converted second analog signal.” See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth

Claim 22 of the '802 Patent	**Prior Art Reference – Rao**
	is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2, \ldots, N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

Claim 22 of the '802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by $\pm 1/(2\Delta t)$, $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, $\Delta t = 1/(N\Delta f) \approx 1.9$ nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 22 of the ’802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

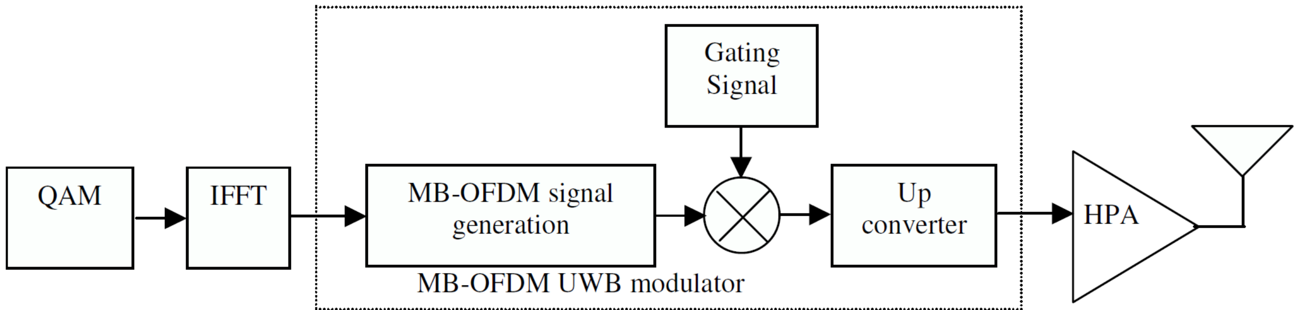
Claim 22 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 23 of the '802 Patent	Prior Art Reference – Rao
[23.1] The communication system of claim 17	Rao discloses all the elements of claim 17 for all the reasons provided above.
[23.2] wherein first and second data to be transmitted comprise a plurality of OFDM symbols, wherein a first symbol is transmitted during a first time slot across the first up-converted frequency range and a second symbol is transmitted during the first time slot across the second up-converted frequency range, and wherein a third symbol is transmitted during a second time slot across the first up-converted frequency range and a fourth symbol is transmitted during the second time slot across a second up-converted frequency range.	Rao discloses "wherein first and second data to be transmitted comprise a plurality of OFDM symbols, wherein a first symbol is transmitted during a first time slot across the first up-converted frequency range and a second symbol is transmitted during the first time slot across the second up-converted frequency range, and wherein a third symbol is transmitted during a second time slot across the first up-converted frequency range and a fourth symbol is transmitted during the second time slot across a second up-converted frequency range." See, e.g.: One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14 (MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth.

Claim 23 of the '802 Patent	Prior Art Reference – Rao
	Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See, e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3) where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and ℜ denotes the real part of a complex number.

Claim 23 of the '802 Patent	Prior Art Reference – Rao
	Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560. Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.

Claim 24 of the '802 Patent	Prior Art Reference – Rao
[24.1] An electronic circuit comprising:	To the extent the preamble is limiting, Rao discloses "An electronic circuit comprising." See, e.g.: UWB technology is a wireless protocol for high-speed data transmission over short distances and has recently received a lot of interest from the wireless manufacturing and user community [1]. The Federal Communications Commission (FCC) has approved to operate UWB in the 3.1- 10.6GHz band at a low effective isotropic radiated power(EIRP) of -41.3 dBm/MHz with a minimum signal bandwidth of 500MHz. In near future, UWB communication system will be extensively used in the mobile handsets or consumer device that require real-time transmission of highdefinition multimedia data. *See, e.g.*, Rao at 559. Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art.

Claim 24 of the '802 Patent	Prior Art Reference – Rao
	Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[24.2] a first down-converter circuit having a first input coupled to receive a first up-converted signal, a second input coupled to receive a first demodulation signal having a first RF frequency, and an output, wherein the first down-converter circuit outputs a first down-converted signal on the first down-converter output;	Rao discloses "a first down-converter circuit having a first input coupled to receive a first up-converted signal, a second input coupled to receive a first demodulation signal having a first RF frequency, and an output, wherein the first down-converter circuit outputs a first down-converted signal on the first down-converter output." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is

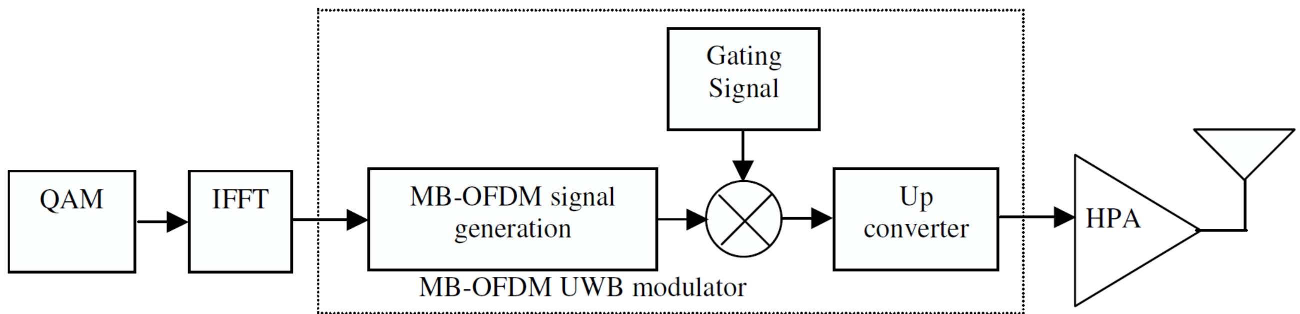
Claim 24 of the '802 Patent	**Prior Art Reference – Rao**
	used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See, e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\dots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

Claim 24 of the ’802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 24 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION (table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

Claim 24 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[24.3] a second down-converter circuit having a first input coupled to receive the first up-converted signal, a second input coupled to receive a second demodulation signal having a second RF frequency different than the first RF frequency, and an output, wherein the second down-converter outputs a second down-converted signal on the second down-converter output, wherein the first up-converted signal comprises a first signal modulated at the first RF frequency and a second signal modulated at the second RF frequency; and	Rao discloses "a second down-converter circuit having a first input coupled to receive the first up-converted signal, a second input coupled to receive a second demodulation signal having a second RF frequency different than the first RF frequency, and an output, wherein the second down-converter outputs a second down-converted signal on the second down-converter output, wherein the first up-converted signal comprises a first signal modulated at the first RF frequency and a second signal modulated at the second RF frequency." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between

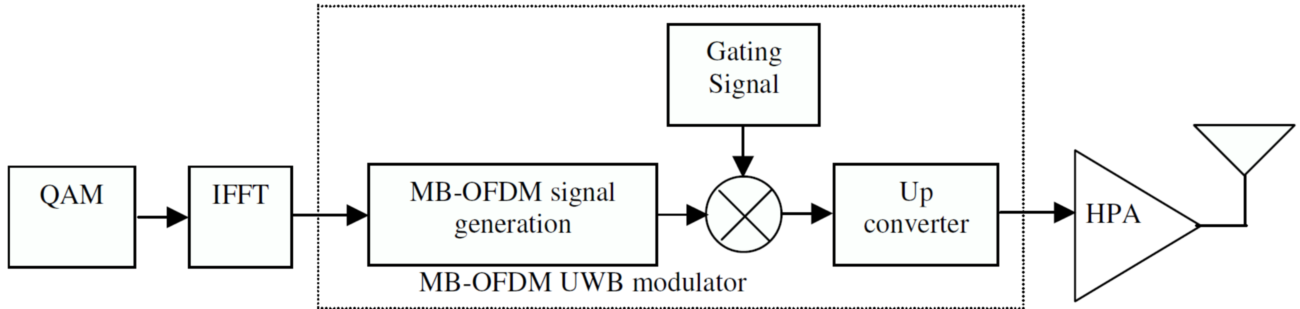
Claim 24 of the ’802 Patent	Prior Art Reference – Rao
	center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$. This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots, N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as

Claim 24 of the ’802 Patent	Prior Art Reference – Rao
	$$u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right) \qquad (3)$$ where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and ℜ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 24 of the '802 Patent	Prior Art Reference – Rao
	TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 24 of the '802 Patent	Prior Art Reference – Rao
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.
[24.4] a filter having an input coupled to the output of the first down-converter and the output of the second down-converter, and in accordance therewith, the filter receives the first and second down-converted signals.	Rao discloses "a filter having an input coupled to the output of the first down-converter and the output of the second down-converter, and in accordance therewith, the filter receives the first and second down-converted signals." See, e.g.:  Figure 1. MB-OFDM UWB signal transmitter *See, e.g.*, Rao at Figure 1. One approach to designing a UWB system based on OFDM is to combine the modulation technique with a multibanding approach, which divides the spectrum into several sub-bands, whose bandwidth is approximately 500 MHz [2]. The band allocation is given in Table.1. The relationship between center frequency and band number is given by the following equation Band center frequency $2904 + 528 \times n_b, n_b = 1 \ldots .14(MHz)$.

Claim 24 of the ’802 Patent	Prior Art Reference – Rao
	This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1 – 10.6 GHz. Based on this, five band groups are defined, band group 1 is used for mandatory mode and the remaining band groups are reserved for future use. The transmitted OFDM symbols are time-interleaved across the sub bands. An advantage of this approach is that the average transmitted power is the same as a system designed to operate over the entire bandwidth. Other advantages of multibanding include processing the information over much smaller bandwidth (528 MHz), which reduces power consumption and lowers cost and improving spectral flexibility. *See*, *e.g.*, Rao at 559. The 128-tone (16-QAM symbols) coefficients are inverse transformed to obtain data block samples by $d_m = \frac{1}{N}\sum_{n=0}^{N-1} D_n \exp\left(\frac{j2\pi mn}{N}\right); m = 0,1,2,\ldots,N-1$ (1) where D_n is the n^{th} QAM symbol and N =128 [3]. The MB-OFDM symbol is formed by placing the data block between the 32-sample zero prefix and 5-sample guard interval suffix making the total symbol length of L =165 samples. A scheme for MB-OFDM UWB signals is shown in Fig.1. The k^{th} MB-OFDM symbol is $u_{k,l} = \begin{cases} 0 & 1 < l \leq 32 \\ d_{l-33} & 32 < l \leq 160 \\ 0 & 160 < 6 \leq 165 \end{cases}$ (2) Then the simulated MB-OFDM signal is mathematically described as $u(t) = \Re\left(\left(\sum_{k=-\infty}^{\infty}\sum_{l=1}^{L} u_{k,l} h_{rect}(t - kT_{OFDM} - (l-1)\Delta t)\right)\exp(-j2\pi f_c t)\right)$ (3)

Claim 24 of the '802 Patent	**Prior Art Reference – Rao**
	where h_{rect} is a filter with a rectangular frequency response bounded by ±1/(2Δt), $T_{OFDM} = L\Delta t$ = 312.5 nanoseconds is the MB-OFDM symbol period, Δt =1/(NΔf) ≈1.9 nanoseconds, and $\Re$ denotes the real part of a complex number. Finally, MB-OFDM signals hop between 14 band center frequencies according to the specified time-frequency code. The band allocation is shown in Table 1 [2]. *See, e.g.*, Rao at 560.

Claim 24 of the '802 Patent	**Prior Art Reference – Rao**
	TABLE 1 – OFDM PHY BAND ALLOCATION (see table below) *See, e.g.*, Rao at Table 1.

TABLE 1 – OFDM PHY BAND ALLOCATION

Band Group	Band ID	Lower Frequency (MHz)	Center Frequency (MHz)	Upper Frequency (MHz)
1	1	3168	3432	3696
	2	3696	3960	4224
	3	4224	4488	4752
2	4	4752	5016	5280
	5	5280	5544	5808
	6	5808	6072	6336
3	7	6336	6600	6864
	8	6864	7128	7392
	9	7392	7656	7920
4	10	7920	8184	8488
	11	8488	8712	8976
	12	8976	9240	9504
5	13	9504	9768	10032
	14	10032	10296	10560

See, e.g., Rao at Table 1.

Claim 24 of the ’802 Patent	**Prior Art Reference – Rao**
	Furthermore, this claim element is obvious in light of Rao itself, when combined with any of the other references as charted for this claim element in Exs. A-1–A-31, First Supplemental Ex. A-Obviousness Chart, and/or when combined with the knowledge of one of ordinary skill in the art. Motivations to combine may come from the knowledge of the person of ordinary skill themselves, or from the known problems and predictable solutions as embodied in these references. Further motivations to combine references and additional details may be found in the Cover Pleading and First Supplemental Ex. A-Obviousness Chart.